BEHAVIOUR OF C-SECTION COLD-FORMED STEEL WITH MULTIPLE OPENING

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Kertas ini mewakili penyelidikan mengenai tingkah laku struktur tiang keluli terbentuk sejuk yang terjejas oleh interaksi distorsional setempat. Struktur keluli terbentuk sejuk telah digunakan secara meluas dalam industri pembinaan dan telah muncul sebagai penyelesaian pilihan untuk bangunan komersial dan perindustrian satu tingkat. Pada kebiasaan keluli terbentuk sejuk dibuat dengan lubang untutk menampung saluran paip, elektrik dan pemanasan di dinding dan siling bangunan. Kajian ini akan tertumpu pada kesan perforasi pada tiang keluli terbentuk sejuk jenis C. kaedah yang digunakan untuk eksperimen ini adalah ujian mampatan yang mana specimen tiang dimampatkan antara dua plat dengan hujung tetap. Dua siri tiang keluli terbentuk sejuk C-section akan digunakan dalam eksperimen ini dengan kedalaman yang berbeza iaitu 103 mm dan 203 mm masing-masing. Terdapat lima bilangan spesimen untuk setaip siri. Setiap spesimen mempunyai ketebalan nominal 1.2 mm dan panjang lajur 600 mm. Ajakan spesimen semasa ujian dibaca oleh transducer. Hasil kajian ini menunjukkan beban maksimum setiap spesimen berbeza dengan kedudukan perforasi dan saiz spesimen. Graf beban maximum melawan anjakan akan mengkaji pergerakan bebibir semasa ujian mampatan. Tingkah lakunya boleh dilihat sepanjang kajian dimana keleturan distorsional akan berlaku pada spesimen tersebut. Kebanyakan spesimen akan gagal di lubang.

ABSTRACT

This paper represented a research on the structural behaviour of cold-formed steel columns affected by local-distortional interaction. Cold-formed steel structural have been widely used in the construction industry and have emerged as a preferred solution for single-storey commercial and industrial building. Commonly, cold-formed steel was manufactured with holes to accommodate plumbing, electrical, and heating conduit in the walls and ceilings of the buildings. This research will be concentrated on the effect of the perforation on the C-section cold-formed steel column. The method used for this experiment was compression test which are the column specimens were compressed between bearing plate with fixed ends. Two series of single C-section cold formed steel column will be used in this experiment with different depth which is 103 mm and 203 mm respectively. There are five numbers of specimens for each series. Each member has nominal thickness of 1.2 mm and the column length of 600 mm. The displacement of the specimen during testing was read by the transducer. The result of this experiment shows the ultimate load of each specimen varies with the position of the perforation and the depth. The graph of load-displacement will studied the movement of the flange during the compression test. The buckling behaviour can be seen along the experiment which is the distortional and local buckling will occur on the specimens. Most of the specimen will failed at the hole.

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LIST OF ABBREVIATIONS

CFS	Cold-formed Steel
DSM	Direct Shear Method
UTM	Universal Testing Machine
SPCC	Steel Plate Cold rolled Common
JIS	Japanese Industrial Standard
LVDT	Lateral Vertical Displacement Transducer
T2	Transducer 2
T3	Transducer 3

CHAPTER 1

INTRODUCTION

1.1 Introduction

In the current industry sector, cold-formed steel (CFS) are wildly used specifically in building structures like transportation machineries, storage racks, domestic equipment’s and others. Cold-formed steel sections are manufactured with difference process such as folding, press-breaking and rolling. Nowadays, cold formed steel are wildly available with difference sizes and shapes (Reddy et al, 2016). Cold formed steel structural members may lead to a more economic design than hot-rolled steel members as a result of their superior strength to weight ratio and ease of construction. Figure 1.1 (a) and (b) shows the differences between hot-rolled section and cold-rolled section that used in building construction. Light gauge cold-formed steel members are commonly used as wall studs and chord members of roof trusses in steel frame housing and industrial building (Young, 2008).

Cold-formed steel structural members are commonly provided with holes to accommodate plumbing, electrical, and heating conduit in the walls and ceilings of buildings. These holes are typically located in the web of C, E, and Z section and can alter the elastic stiffness and ultimate strength of a structural member (Moen et al, 2008). The holes often punched out in the webs and flanges of cold-formed members. The presences of the holes may result in a reduction of the strength of individual component elements and of the overall strength of the member (Sivakumaran, 1987). The ultimate strength is driven by local buckling and yielding the cross-section. The column lengths and cross-section dimensions are specifically chosen to explore the connection between local, distortional, and global elastic buckling modes, ultimate strength, and the resulting failure mechanism (Moen et al., 2008).

The edges stiffeners are commonly used in cold-formed steel section provide continuous support along the longitudinal edge of the flange to enhance the buckling stress. It can be easily brake-pressed or roll-formed on the free edge of an unstiffened plate. Therefore, cold-formed sections having edge stiffeners can lead to an economic design as a result of higher buckling stress of the sections. However, local buckling stress could be enhanced by adding intermediate web stiffeners (Young, 2008). The presences of holes will increase the buckling strength of the webs (Crisan et al, 2012).

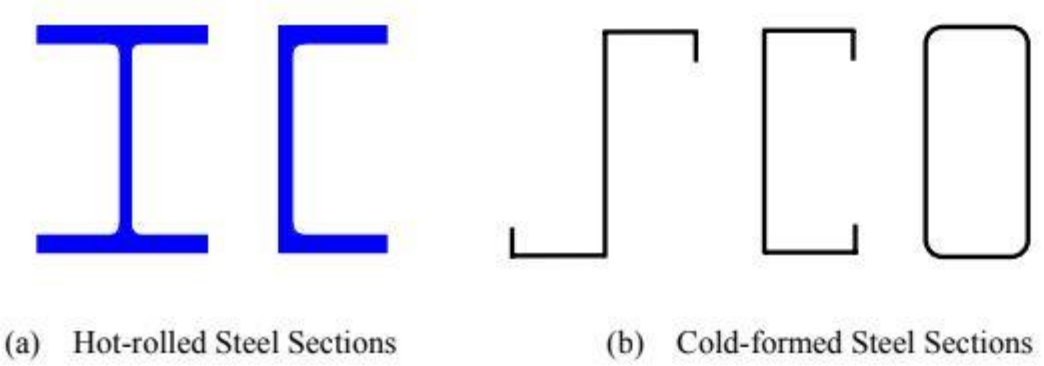

Figure 1.1 Steel section used in building construction

1.1.1 Application of cold-formed steel

Nowadays, cold-formed steel member are widely used in building construction, such as wall studs, floor joists, truss members and other structural application. Figure 1.2 (a) and (b) shows the structural framing that widely used in construction. While, Figure 1.3 and Figure 1.4 shows the application of the cold-formed steel member which is residential and rack system.

(a) Commersial building (b) Residential

Figure 1.2 Structure framing

(a) House (b) Rack system

Figure 1.3 Common usage of the cold-formed steel

1.2 Problem Statements

Cold-formed steel are widely used in construction industry. Many structural cold-formed steel members are provided with cut-outs to accommodate electrical, plumbing, and heating services and the perforations are either pre-punched or punched on site. Cold-formed steel easily shaped compared to hot-rolled steel. Nowadays, in structural building construction, cold-formed structural members are becoming more popular and have a growing importance which is it have been used as a main structure such as column. As known, column is a main structure in a building which it is act as a key structure that transmitted load to foundation and then to the ground. Because of

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